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THE EDUCATION OF HEALTH OFFICERS.[1]

By GEORGE C. WHIPPLE, Professor of Sanitary Engineering, Harvard University.

The world stands to-day in great need of competent physicians, nurses, sanitary engineers, and public-health executives. There are medical schools in almost all countries and, though these schools differ in excellence, their programs of study run along the same general lines and include many of the latest developments of medical science. The nursing service is far behind that of medicine, although it is an important adjunct to it. In many countries there are no trained nurses, the service being in low social standing and the hospital conditions being such as to repel the kind of young women needed. Adequate schools for nurses are few in number and the numbers of students in them are small. The profession of sanitary engineering is almost unknown except in a few countries, and yet it is the men in this profession who must be depended upon to construct and safeguard public water supplies, build sewers and drain swamps, manage the disposal of wastes, and solve the problems of plumbing, ventilation, and other matters connected with the healthfulness of man's environment. Sanitary engineering is taught, in part at least and under other names, in schools of engineering, but usually without sufficient attention being given to its public health relations. Opportunities for students to receive instruction in public health administration are still more limited, and the consequence is that, outside of a few countries, there is a great dearth of competent health officers. Yet there are ministries of health, departments of public health, local boards of health, and the like, which are constantly creating new offices to be filled. More and more the need of employing men specially trained for this field of administration is being felt. There are only a few real schools of public health in the world to-day, and these, with one exception, are all small and inadequately endowed.

It is the purpose of this report to describe briefly what constitutes an adequate training for health officials and to outline a program suitable for a course of study in this field.

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Difference Between Public Health Administration and Medical Practice.

At first thought one would naturally say that doctors of medicine ought to make the best health officers and, as compared with the other professions, that is true. There was a time a few generations ago when boards of health were commonly composed of laymen or civil officials, who, by virtue of their office, acted in matters pertaining to the public health. It was a step in advance when the laws were so changed as to bring medically trained men into this service. But conditions have changed. The age of power, with its factory system, its quick transportation, its concentration of people in cities, its larger and higher buildings, has brought with it a greater need of governmental control of sanitation. Science, especially biological science, has brought in new methods of preventive medicine, while medical science itself has become specialized. The spread of education and the rising tide of democracy are offering ever greater opportunities for the people to take active part in the protection of their own health. The health movement has risen like a flood and is overflowing the banks of the medical profession. It is well-nigh impossible for medical students to acquire all the information and skill required for modern curative practice and at the same time keep abreast of the times in the collateral science of preventive medicine and the arts of sanitation.

Furthermore, there is a fundamental difference between the health administrator and the physician. The physician centers his interest upon individuals; he gives personal service; his success lies in his own personality and in his ability to utilize the means which medical science has placed at his disposal. The health administrator, on the other hand, deals not with individuals but with masses of people. His service is impersonal. Sometimes he must even forget individuals in the interest of preserving the health of the community. Medical knowledge he must have, but with it he must have the power to generalize, to think in mathematical, engineering, and legal terms, to understand the relation between community health and community environment. The physician, especially if he be a surgeon, must have skill in minutiæ; the health officer must be a sanitary statesman. The physician must possess the quality of human sympathy; the health officer must possess the quality of justice. Health administration does not require a higher type of mind than medical practice; it does require a different type of mind. Numerically the physicians do and probably always will greatly outnumber the health administrators.

Another fact must be taken into account. Greater emphasis than formerly is now being given to the positive side of health. Health is more than the absence of disease; it includes comfort, vigor, ability to work efficiently, and ability to enjoy life. Amelioration of insanitary conditions for the sake of human comfort, cleanliness for its moral influence, exercise, athletics, and attention to posture and the movements of the body are parts of the modern health movement. So also are the efforts to lessen fatigue in factory labor. These are matters of hygiene, but of a hygiene focused upon normal living and not upon abnormal conditions. They also extend outside the ordinary realm of the physician.

With these ideas in mind it seems probable that the time is near when there will be schools of health side by side with the medical schools and interlocking with them. They will be like two vines twined at the bottom to form a single stalk, but spreading apart gradually as they put forth their leaves and fruit.

General Education of Public-Health Officers.

Before laying out a detailed program of studies and training suitable for students intending to be public-health executives it will be well to consider the subjects in a general way.

First of all, emphasis must be placed on personal qualifications and general education. The men who are to be leaders in public health must by their presence and personality be able to influence people. They will be brought in contact not only with legislation and public officials but with the general public. They will have occasion to meet the educated, and their own education must not fail them; they will have to meet the poor and the ignorant, and their sympathy must not be lacking; they will have to address public audiences, and they must be able to speak effectively; they will have to write reports and scientific papers, and they must be able to do this with accuracy, clearness, and simplicity. They must be themselves in good physical condition, lest people say, "Physician, heal thyself." Too much importance can not be placed on these basic requirements.

The desirable elements of the preliminary education of a public-health official may be classified as follows. Obviously not all of the subjects mentioned can be studied deeply, and great differences must exist between individuals in the emphasis which they give to different subjects. This list, however, will serve to call attention to the need of a solid educational foundation.

I. *Studies which give a knowledge of man and his environment.*—Anatomy, physiology, psychology, religion, anthropology, ethnology, astronomy, meteorology, geography, geology, physics, chemistry, botany, zoology, entomology, etc.

II. *Studies which give potential power.*—History: Of nations, governments, social conditions, sciences. Biography: Especially of men of science. Literature: The classics, general reading, public documents, etc. Art: Poetry, music, fine arts, architecture. Human relations: Government, economics, business, sociology, law.

III. *Studies which give dynamic power.*—Mathematics: Arithmetic, algebra, geometry, calculus, etc. Language: French, English, German, and other modern languages; also Latin and Greek. Thought: Logic, philosophy, statistics. Self-expression: Writing, public speaking, drawing. Physique: Military discipline, athletics, use of tools.

It will be seen that these are the general requirements for the well-educated man in any profession. No one man can become proficient in all these lines, but every man who aspires to be a health officer should acquire as broad a knowledge as possible of man and his environment and do all that he can to acquire both potential and dynamic power in order that he may make his acquired knowledge useful.

Physics, chemistry, and biology are the foundation of public-health science as well as of medical science. No one is fitted to undertake a course of study in public health unless he understands the general principles of these fundamental sciences. A working knowledge of mathematics—arithmetic, algebra, and geometry, at the very least—is presupposed. Biology includes bacteriology, botany, and zoology. Familiarity with ordinary laboratory procedures and the use of physical and chemical apparatus is essential. Persons beyond the ordinary student age who decide to study for the profession of public health should review their physics, chemistry, and biology, and also spend some time in a laboratory for the purpose of becoming familiar with various instruments and acquiring skill in manipulation. A few weeks spent in this preparatory work will save time and add to the understanding of the subjects studied later on.

Basic Medical Sciences.

The basic medical sciences are anatomy, physiology, and pathology. One can not imagine a well-equipped physician or a well-educated health official who does not understand the mechanism of the human body and its most common diseases. Closely associated with anatomy is histology; closely associated with physiology are embryology and biochemistry; and intimately associated with pathology are parasitology and bacteriology. These fundamental medical studies are usually pursued during the first two years in the ordinary medical school and they should be included also in the program of a school of public health.

Next come the more professional subjects of medicine, surgery, and pharmacology. In medical schools these studies are commonly begun during the second year but continued throughout the program, becoming more and more detailed and specialized in the later years.

The student of public health should study the elements of medicine, surgery, and pediatrics. He will have use for this knowledge, but he will very rarely have occasion to use the specialized knowledge of the practising physician in pharmacology, obstetrics, gynecology, dermatology, orthopedics, otology, ophthalmology, laryngology, neurology, and the other detailed branches of medical science. These special subjects, with their clinics and laboratory courses, usually occupy the medical student one or more years, and this time the student of public health can spend to better advantage in other directions. In a word, the subjects which the medical student ordinarily pursues during the first two or three years of a four-year medical school program should also be pursued by the student of public health.

Two other subjects studied by most medical students are becoming more and more important in medical practice, namely, hygiene and preventive medicine, hygiene being an outgrowth of physiology, and preventive medicine largely an extension of bacteriology. To the student of public health these subjects become professional.

Professional Studies of the Student of Public Health.

In addition to the fundamental sciences of chemistry, physics, and biology, the basic medical sciences of anatomy, physiology, and pathology, and the professional medical subjects of medicine, surgery, and pediatrics, there are five branches of knowledge upon which the health official must depend in the exercise of his usual functions, which may be classified as follows:

1. *Hygiene.*—This treats of the physiological relations of human beings to their environment, the influences of climate, mode of life, and the effect of the conditions found in the home, the school, the factory, and all the other varied conditions under which people live, work, and play. Hygiene differs from sanitation in that it approaches the environmental condition from the physiological standpoint. Hygiene is often subdivided according to age, as prenatal hygiene, infant hygiene, child hygiene, sex hygiene, etc.

2. *Sanitation.*—This also treats of environmental conditions, but it approaches them from the standpoint of the engineer. Sanitation puts into practice the ideas which hygiene suggests. It has to deal, with the forces of nature, with materials, with the use of structures, and even machinery. Specifically, it includes such matters as the purification of water, the pollution of streams, the disposal of sewage, the removal of solid wastes, ventilation, plumbing, heating, lighting, the drainage of swamps, the construction of buildings to make them rat proof. The health officer does not need to study these subjects in the detailed manner required of the sanitary engineer, who must understand the art of designing, but he needs to understand engineer-

ing terms, to be able to read maps and plans, to appreciate the cost of engineering work, to know when desirable hygienic projects are practically possible, to know how to test sanitary devices to assure their proper operation.

3. *Preventive medicine.*—In a broad sense preventive medicine ncludes the whole subject of preventing the spread of communicable diseases, but viewed as a professional subject it relates especially to the application of bacteriology, protozoology, and parasitic entomology. It deals with laboratory methods of diagnosing disease, with disinfection, with the preparation and use of vaccines and sera, with the transmission of disease germs by vehicles and intermediate hosts. Naturally it interlocks with hygiene, sanitation, and epidemiology.

4. *Statistics.*—This covers the collection, analysis, and practical use of vital statistics—population, births, marriages, deaths, causes of disease, and all of the related facts. The science of statistics is the handmaid of all the other branches of public health work. It is the very foundation of epidemiology. It is a lack of willingness to use mathematics which unfits so many physicians for public health work, and for that very reason it deserves especial attention in a course in public health.

5. *Public health administration.*—This covers the practical work of the executive health official in all its details. It includes the principles of public health law and legislation; the philosophy of organization; public health education; the routine work of health departments, laboratories, hospitals, clinics, dispensaries; the inspection service; legal medicine; analysis of food and drugs.

These five groups of professional subjects might, of course, be arranged in a somewhat different way, according to the definitions given to the terms used. For example, "hygiene" is sometimes made to cover both hygiene and sanitation; "preventive medicine" is sometimes made to include statistics and epidemiology; "administration" might include statistics and preventive medicine. The mere grouping of the subjects is of secondary importance; the main thing is to have all of the subjects covered and given their proper emphasis.

Is the Medical Degree Necessary for Health Officers?

It may be inferred from the preceding paragraphs that the medical degree is not necessary for a person who is to become a public-health executive. From the academic standpoint that is true. The present-day medical student spends nearly two years of his time studying subjects which are of infrequent use in public-health administration. In the interest of efficiency and economy of effort this time could be better spent in studying the professional subjects more definitely useful, as already pointed out. Some who have studied the subject go so far as to say that the kind of study required of the medical student tends to dull the perception of the broader aspects of public-health work. Whether or not this is true, it seems to be certain that the actual practice of medicine in the ordinary way does make it more difficult for a person to take up the work of public-health administration. In this realm, as in so many others, youth is the time for training.

Educational evolution seems destined to work out a fairly clear-cut difference between curative medicine and preventive medicine. One of two things seems bound to happen. Either the medical profession will have two branches, which Prof. Sedgwick has recently likened to the letter Y, or a new profession of public health will grow up side by side with the medical profession. The writer believes that in the long run the former alternative will yield the better results to the community. It is of the greatest importance to the health of the world that there be no antagonism between public-health officials and physicians, for both are working for the same end—the preservation of life and the amelioration of human suffering. Differences there must be, but the bonds of union must be kept strong enough to overcome the tendencies toward separation.

The time is coming when in well-organized communities this division of labor will be fully recognized and when doctors of public health (they may, perhaps, be given some other title) will be on an equal footing, professionally, with doctors of medicine. But it must not be forgotten that not all of the countries of the world are to-day well organized, and that it is the actual conditions with which we are immediately concerned. Where the social organization is imperfect there is usually a shortage of physicians, and the health officer may have occasion to give professional advice. This is also true in sparsely settled areas. Even when not asked to give advice he may be called upon to visit patients, to make diagnoses, or to confer with the physician in charge. Medical knowledge is, therefore, essential.

Another reason in favor of the medical degree for the health officer is that he must often work with and through the medical practitioners. If he is a regular member of the profession, he finds himself in better standing and can accomplish more than if he is not a doctor of medicine. This is because the guild spirit is strong. The time is coming, however, when doctors of public health and doctors of medicine will regard each other as colleagues, and when the public will look upon them as equals.

In some places the objection to non-medical health officers has been put upon a low plane. The income of the health officer is usually on a salary basis, while that of the practising physician is based on fees. The latter is usually larger. Physicians have feared that young men, not having the M. D. degree but receiving only some sort of diploma or certificate in public health, might use this as a means of obtaining fees for medical treatment, thus building up unfair competition and casting discredit on the medical profession by giving poor service. So far as the writer has been able to learn, this objection is fanciful rather than real. Quacks and impostors exist around and in all professions. When one considers the character of the studies required by the health officer, it ought to be evident that men capable of securing the degree of doctor of public health must be of equal mentality with those who obtain the degree of doctor of medicine. This argument is one which will vanish when the qualifications required for the health officer and his close association with the practising physician become better known. It will also vanish when the salaries of health officers are placed upon a plane which will give them an income approaching that of the private practitioners, when their tenure of office is secure and respect for their position increased. It must be remembered, however, that service in the interest of the public must, and ought to be, to a large extent, a labor of self-sacrifice. It is not, and ought not to be, a place for making money.

Quite a different objection to non-medical officers of health is that at present such officials are chiefly in the public service, a service which is often disarranged and the personnel changed at the whims of politicians. This puts limits upon the individual. If, however, the incumbent holds a medical degree, he may, if deprived of his official position, engage in the practice of medicine; on the other hand, it may be argued that long practice as a health officer may unfit the individual for private medical practice.

Consideration of these and minor arguments has led the writer to hold the opinion that, for the conditions of the immediate present and looking at the matter as a world problem, the greatest need is for public health executives who have had both a medical degree and some other degree, diploma, or certificate in public health. Whether the medical course be pursued first and followed by a course in public health or whether the public-health studies be interspersed with medical studies is a matter of relatively minor importance. This opinion is frankly pragmatical and based upon the fact that there is an immediate need of health officers in many countries and that the lines of least resistance are in the direction of securing the necessary personnel most readily from the medical profession. At the same time, the writer wishes to register his conviction that the best way to educate health officers is that of specialization along the lines mentioned; that is, with a proper combination of medical studies and professional public health studies. He believes that in the more highly organized countries this method should be adopted as soon as the necessary changes can be brought about.

It was a step in advance when, in some countries many years ago, it was required that health executives be physicians. It was a second step in advance when in England it was required that medical officers of health have not only the medical degree but the diploma of public health. It will be a third step in advance when the degree of doctor of public health will be required with, or in place of, the medical degree. In some places not even the first step has been taken. In many countries the second step has not been taken. Nowhere as yet has the third step been taken. Looking at the matter broadly, it would seem wise to concentrate our major efforts at the present time in attempting to consolidate opinion on the second stage, namely, that of requiring that public health executives be medical men with supplementary training in public health.

If these ideas be sound, it follows that we now have a double problem to solve or, rather, two programs to arrange—a relatively short program of studies which form an adjunct to the present medical course leading to the granting of a certificate or diploma in public health, and another program extending over a longer period leading to the degree of Doctor of Public Health or some similar degree.

Hygiene as Taught in Medical Schools.

In most of the well-conducted medical schools of the world there are professorships of hygiene. Some of the courses given are broad and well arranged, but usually the time allotted to them is far too short. Many of the medical schools are well provided with laboratories and museums. In some places the professor of hygiene is also at the head of a local or regional public-health service, and the laboratories of this service are available for instructional purposes. One result of this combination of executive and educational work is that the professor becomes overworked. As a rule, the courses are given by men who have been trained chiefly along medical lines, and their point of view is not broad enough. Moreover, the courses do not receive proper attention from the students, as their thoughts are centered on their own future practice. In spite of their shortcomings, these departments of hygiene in the medical schools are most important, as they offer an excellent basis for the establishment of schools of public health.

The writer has had the opportunity of visiting some of the departments of hygiene in the universities of America, Canada, England, France, Switzerland, and Rumania, and has received descriptions of the courses from many other countries, including Belgium, Italy, Spain, India, Holland, Denmark, and Sweden. Practically all the medical schools now have courses in bacteriology and facilities for laboratory work. This instruction is sometimes given in connection with that in hygiene.

The Diploma in Public Health in Great Britain.

Most of the English universities provide instruction and give examinations which lead to the granting of a "Diploma in Public Health." Since 1888, this diploma, or its equivalent, has been required of public-health executive officers of sanitary districts which have a population exceeding 50,000. They are known as "Medical Officers of Health." The conditions for the granting of the diploma in sanitary science, public health, or State medicine were first laid down by the General Medical Council in 1902. Committees of the council visit the universities from time to time to inspect the manner in which the courses and the examinations are administered.

The course of study usually requires a full calendar year. The medical degree is prerequisite. The administration of the diploma in public health is in charge of the medical faculties of the universities. The details of the courses vary in the different universities, but in general the following conditions are necessary for the granting of the diploma:

1. The degree in medicine.
2. At least nine month's study which must include:
   - (*a*) Prescribed courses in a university, college, medical school, or some other acceptable institute, including at least 240 hours of laboratory work.
   - (*b*) Hospital attendance at least twice a week during three months.
   - (*c*) Practical public health experience under authorized direction, during six months, or actual service as a medical officer of health.

3. An examination, extending over four days, one of which is devoted to practical work in a laboratory and one to practical examination in subjects which fall within the duties of a medical officer of health.

Inasmuch as the prescribed examination sets the standard for the scope of the instruction, it is important to observe what subjects are covered. At the University of Leeds the calendar gives them as follows:

Part I:
1. Chemistry as applied to public health.
2. Physics, including meteorology, as applied to public health.
3. Etiology of disease.
4. Practical pathology and bacteriology.
5. Microscopy as applied to public health.

Part II:
1. Engineering as applied to public health.
2. Sanitary law and administration.
3. Vital statistics.
4. Sanitary reporting.

In other universities the titles are sometimes phrased differently, but in general the first part of the examination is theoretical and covers general principles, while the second part is practical and covers the application of science to state medicine and the various details of administration. The examination subjects as given above may be regarded as typical of those at other universities.

A more detailed statement of the examination is given in the statutes of the University of Oxford, as follows:

Part I:

(*a*) A written paper of three hours in chemistry and physics on the subjects of—

Air: Examination of air; recognition and determination of impurities. Moisture in air.

Water: Rainfall. Sources and characters of waters. Purification and softening. Methods of analysis. Distribution and supply to consumers.

Soils: General composition and relation to geological formation. Methods for determination of moisture and water-retaining power.

Ventilation and warming.

Removal and disposal of sewage, house refuse, trade refuse.

Offensive trades in their chemical and physical aspects. Disinfectants.

Examination of foods by chemical and microscopic methods. Detection of metallic impurities, adulterations, preservatives, or added substances.

(*b*) A three-hour practical and *viva voce* examination in chemistry and physics, in which the candidates will be expected to exhibit a practical acquaintance with the ordinary methods of analysis and examination used in investigations concerning the subjects of the written examination.

Part II:

(*a*) Two written papers each of three hours, dealing with general hygiene (including sanitary engineering, vital statistics, and the laws relating to public health), which shall comprise—

The construction, drainage, heating, and ventilation of dwellings, schools, hospitals, and other similar buildings.

The general sanitation of villages and towns.

Influences which exercise or threaten to exercise an injurious effect on health and physical development.

The etiology, symptoms, and methods of prevention of infections and other preventable diseases.

The effects of food, season, soil, and climate upon health and disease.

Dangerous and offensive trades.

The inspection of food.

The principles and methods of vital statistics.

The laws, statutes, regulations, memoranda, etc., relating to public health.

(*b*) A practical and *viva voce* examination in general hygiene for which candidates will be required to show a practical knowledge of outdoor sanitary work.

(*c*) A written paper of three hours in pathology and bacteriology, which shall include the general pathology of infection by any organism (including a general knowledge of parasitology and helminthology; immunity; the principles of prophylactic and curative inoculations; serum therapeutics).

The special pathological characters of the common human infections;

The patholcgy of the diseases of animals transmissible to man;

The conditions affecting the existence of infective agents outside the animal body;

The pathology of diseases dependent on occupation.

Part II—Continued.

(*d*) A three-hour practical and *viva-voce* examination in pathology and bacteriology, in which candidates will be expected—

  (1) To be able to demonstrate the existence of infective agents in pathological material;
  (2) To recognize cultures of the ordinary pathogenetic bacteria;
  (3) To exhibit a knowledge of the ordinary methods of bacteriological investigation, and of the special methods applicable to the examination of air, food, water, soil, and sewage;
  (4) To be familiar with the appearances presented by food which for bacteriological reasons is considered unfit for consumption.

The examinations are usually not limited to students in the university which offers them, but may be taken by students of other recognized institutions. At Cambridge, for example, the greater number of the candidates for the diploma in public health comprise doctors who have studied elsewhere. This extra-mural instruction in the English universities has not been altogether successful, and there is said to be a growing feeling that the students should be examined in the institutions where they have studied. The present system tends to direct the teaching too much toward the examination topics and too little to the fundamental truths; too much to the acquiring of information and too little to training in methods of work and investigation; too much to providing potential equipment and too little to dynamic equipment.

The university calendars vary considerably in their published statements of the courses offered. The following may be regarded as typical:

UNIVERSITY OF CAMBRIDGE.

1. *General course of lectures on hygiene* (three times a week for three months).—Geology and surface contour in relation to health questions, meteorology and climate, principles of ventilation, water supply, methods of removal and disposal of refuse and sewage.

2. *Chemistry and physics in their application to hygiene* (lectures and demonstrations three times a week for six months, with laboratories open at other times).—Elementary physics, qualitative and quantitative analysis, technical analysis of foods, including the detection of impurities and adulterations in air, water, foods, and beverages, the analysis of sewage and sewage effluents, and antiseptics and disinfectants.

3. *Bacteriology, protozoology, and preventive medicine* (three times a week for three months with additional practical instruction in the laboratory).—General characters of microorganisms, general considerations relating to infective diseases, the cause, mode, and spread, specific treatment and prevention of certain infective diseases, bacterial intoxication, and practical methods.

4. *Practical courses in bacteriology,* covering standard laboratory procedures.

5. *Lectures on sanitary law and vital statistics* (three times a week for one term).—Exposition of public sanitary administration within the United Kingdom, vital statistics, construction of buildings, including drainage, epidemiology, school hygiene, sound and unsound food, trade processes, mental deficiency.

6. *Practical sanitary administration.*—A course of instruction in the duties, routine and special, of public health administration.

7. *Infectious diseases hospital course.*—Carried on under special arrangements in the Cambridge Infectious Diseases Hospital.

UNIVERSITY OF MANCHESTER.

1. *Principles of public health* (ten hours a week for six months).—The relation of various diseases to public health, general character, distribution and properties of microbes; sterilization and disinfection, aetiolcgy of infectious diseases, relation of air, water, food, clothing, dwellings, soil, refuse, etc., to the spread and prevention of disease.
2. *Practical bacteriology and microscopy* (three months), covering ordinary laboratory practice.
3. *Practical comparative pathology* (three months), covering recognition of animal and vegetable parasites, practical meat inspection, etc.
4. *Chemistry as applied to public health* (six months).—Elements of physical chemistry, heat, light, electricity, use of meteorological instruments, practical work with special reference to the examination of air, water, food, soil.
5. *Animal parasites in relation to public health.*—Course of special lectures given during the vacation periods.
6. *Public health administration* (two hours a week for three months).—Sanitary law and administration, sanitary engineering, drainage, sewerage, and disposal of refuse, control of food supplies, nuisances, vital statistics, preparation of reports.
7. *Factory hygiene* (six lectures).
8. *School hygiene* (six lectures).
9. *Practical study of the duties of medical officers of health,* covering a period of six months under the supervision of a medical officer of health.
10. *Practice in administration of hospitals for infectious diseases* (twice a week for three months).
11. *Practice in a hospital for diseases of children and instruction in methods of the examination of the ear, throat, and eye* (three months for candidates for the special certificate in school hygiene).

UNIVERSITY OF EDINBURGH.

1. Chemical laboratory work and meteorology as applied to public health (four hours a day, 200 hours).
2. Sanitary engineering (30 hours).
3. Lectures on advanced public health (three days a week, 30 hours).
4. Bacteriology (three days a week, 120 hours).
5. Administration of infectious disease hospitals, including the recognition of infectious diseases (two days a week, 20 hours).
6. Duties and practical work of a medical officer of health (three days a week, 60 hours, during three months).
7. Entomology and parasitology, including diseases transmissible to man (about 80 hours).
8. Tuberculosis, clinical and administrative (one day a week, 15 hours).
9. Venereal diseases, clinical and administrative (15 hours).
10. Demonstration course of medical inspection of school children by school medical officer (one day a week, 10 hours).
11. Demonstration course of infant welfare (one day a week, 10 hours).

UNIVERSITY OF GLASGOW.

1. Practical instruction in chemistry, bacteriology, and pathology of the diseases of animals transmissible to man (20 hours during the week for eight months, of which five months must be in the public-health laboratory of the University of Glasgow and the other three either there or in a laboratory of recognized standing).
2. Physics and geology, each course covering three months.
3. A medical course dealing with public health (75 lectures).
4. An engineering course dealing with public health (25 lectures).

5. Six months' service acquiring practical knowledge of the duties of public-health administration under a recognized health officer.
6. Three months' practice in a hospital for infectious diseases (at least twice weekly).
7. Instruction in mensuration and drawing (three months).

The Diploma in Public Health Elsewhere.

Canadian practice in awarding the Diploma in Public Health follows closely after that of England. The medical degree is required. The courses are all under the faculty of medicine.

At the University of Toronto there is a winter session of eight months and a summer session of three months. The winter session is devoted to lecture courses in (*a*) sanitary chemistry, (*b*) bacteriology, (*c*) parasitology, (*d*) general hygiene, (*e*) general pathology, including theories of immunity and comparative pathology, (*f*) elements of geology, meteorology, and climatology, in their relation to public health, (*g*) sanitary engineering, (*h*) public-health organization, sanitary legislation, and vital statistics, (*i*) clinics on communicable diseases, (*j*) history of preventive medicine and epidemiology. In the summer session there is a course of field work under the supervision of a recognized board of health, which deals with methods of controlling infectious diseases, inspection of schools, factories, and dairies, water supplies, sewage disposal works, and medical inspection of school children. Provision is made for graduates in medicine prior to 1907 who have acted as medical officers of health for two years, to take the examinations and receive the certificate without attending the courses.

At McGill University there is a similar "Diploma Course in Public Health" based on one year's work in residence, the medical degree or other qualifications for practice being required.

In India and other parts of the British Empire the diploma in public health is administered in substantially the same manner as in England. At Liege, Belgium, a "diplôme spécial de médecin hygiéniste" is given after one year's special study of hygiene, bacteriology, sanitary technology, and administrative medicine. At the Institute of Hygiene at Lyon a certificate is given to graduates in medicine after one year's study of public-health subjects.

The Certificate in Public Health in the United States.

The United States has not yet reached the stage where all health officers are required by law to possess certain qualifications, but in some sections custom is rapidly giving this requirement the force of law. During the last ten years notable progress has been made. Several schools of public health have been established and increased attention is being given to the subject in many universities.

At the present time the certificate in public health does not imply that a definite course of instruction has been received. Efforts have been made to give to the physicians already in office as health officers special training in the newer ideas of preventive medicine by means of short courses of study extending over only a few weeks. This has been useful, but it represents the lowest form of the "certificate." The highest form is represented by the year's instruction as given in the School of Public Health of Harvard University and the Massachusetts Institute of Technology and at the School of Hygiene and Public Health of Johns Hopkins University.

At the Harvard Technology School the medical degree is required of the student who desires to secure the certificate after one year's study, but by attending certain preliminary medical courses in the medical school it is possible for a person to obtain the certificate in public health without a medical degree. It has been found that such persons usually make excellent health officers. The administrative board of the school prefers and recommends that candidates for the certificate shall have the medical degree. The requirements for the certificate are:

1. A medical degree, or sufficient preparation in premedical studies.
2. An approved program of study covering one academic year (eight months), in residence, with an examination in each course.
3. A final oral examination on the general subject.
4. A report of a special investigation, generally in the nature of a sanitary survey.

There is no rigid program of studies, but such subjects as bacteriology, preventive medicine, epidemiology, hygiene, vital statistics, and sanitary engineering form a part of all programs. The courses include hospital clinics, laboratory work, visits to sanitary works, and frequent lectures by officials from the State and local departments of health. All possible efforts are made to tie up the university instruction with actual work. It has been found desirable to allow considerable latitude in the choice of subjects, as many of the students are preparing themselves for special fields of work. Industrial hygiene forms an important and separate branch of the school. Women are admitted on the same terms as men.

At the School of Hygiene and Public Health of Johns Hopkins University the program of studies for the certificate in public health is also varied, but must include epidemiology and such other courses as may be approved by the faculty, the whole amounting to one full academic year's work in residence. The candidates must be either graduates in medicine or graduates in arts or science who have had sufficient previous training in the physical and medical sciences.

There are schools of public health or schools of hygiene created as separate departments of the university at Yale, University of Pennsylvania, Tulane University, and elsewhere, but the above-mentioned notes may be regarded as typical of American practice at the present time.

Miscellaneous Degrees in Public Health.

Practice varies greatly in different universities in the administration of other degrees relating to public health. There are differences in title, in time required, in the subjects taught, and in the methods of teaching. It hardly seems worth while to attempt to standardize them, as at the present time it would serve no useful purpose. It will not be out of place, however, to refer to some of the degrees which are given; for, taken collectively, they indicate a widespread interest in the subject of public health.

In Edinburgh the degree of bachelor of science in public health is given after 18 months' study following the medical degree. The course contains more of the fundamental studies than the diploma course, with much emphasis on engineering subjects. A similar degree is given at Glasgow. At Edinburgh and Glasgow the degree of doctor of science in public health is given, not as the result of following a further prescribed course of study, but after passing an examination and submitting a thesis. This degree is not awarded until five years after the student has received the degree of bachelor of science in public health. At Manchester, Birmingham, and some other English universities the degree of bachelor of science in public health is given. At Durham the degree is called bachelor of hygiene, and there is also a degree of doctor of hygiene given after two years' work of research following the bachelor's degree, which requires an examination and a thesis. At Liverpool the degree of master of hygiene is given after practically two years' work. It should be observed that all of these degrees require the medical degree as a prerequisite.

In the American universities practice in granting degrees in the field of public health has been quite varied, as these degrees have not been administered in response to any single controlling idea. There are numerous branches of the public-health service and many programs of study have been arranged looking toward specific lines of work. Among the degrees given are: Bachelor of science in hygiene, bachelor of science in public health, master of public health, master of science in public health, doctor of science in hygiene, doctor of science in public health, doctor of philosophy in public health, doctor of medical sciences. Allied to these are the bachelor of science in sanitary chemistry, bachelor of science in sanitary engineering, master of science in sanitary engineering, and so on. For these various degrees the degree of doctor of medicine is not usually required, hence these degrees can not be readily compared with the English degrees of somewhat similar titles. It hardly seems worth while to attempt to standardize them, as educational opinion is tending strongly toward the diploma (or certificate) in public health as the minimum requirement for executive public-health positions and toward the degree of doctor of public health as the highest degree in that field. In a general way the American degree of master of public health, given in one year after the bachelor's degree in a course which includes the basic medical subjects, may be taken as corresponding to the certificate in public health.

Typical One-Year Diploma Course.

After studying critically the various programs of studies leading to the granting of a diploma of public health in the medical faculties of English and Canadian universities, the "certificate" programs in the American schools of public health, and the courses in hygiene in the medical schools of these and other countries, the writer has formulated an outline of studies and training which it is hoped may be regarded as a model worthy of being followed by universities where instruction in public health is not now given. This program is based on the following fundamental ideas:

Candidates for the diploma in public health should be graduates in medicine. If more than about five years have lapsed since receiving their medical degree, it is desirable that they should take a special review course during their first term, as experience has shown that such persons are often rusty on many of the elementary subjects, such as mathematics, chemistry, physics, and methods of laboratory manipulation.

The program should cover one calendar year. There should be about eight months of academic work in residence followed by three months of practical work, preferably in the summer, with an allowance of one month for vacations. The academic work would ordinarily be divided into two terms.

During the first two terms there should be not more than five principal studies in progress at any one time, and these should cover 80 or 90 per cent of the student's working time. In some institutions it might be more convenient to have one subject follow another according to the so-called intensive plan. Some time should be left for extra lectures and special studies of particular interest to the candidate. In the case of physicians who need the review course, this special time should be devoted to it.

The practical work in the third, or summer, term should be varied according to the needs of each candidate. Clinical work in the hospital, work as assistant to a health officer, the inspection of schools or factories, the making of a sanitary survey, the execution of a special laboratory investigation, or even a tour of visits to notable sanitary works should be regarded as fulfilling the requirement.

There should be an examination for each course given by the instructor, and there should be a general oral examination on the completion of the academic work, given by a special board which should include one or more persons from outside the school engaged in actual public health work.

At the end of the third term and before the diploma is awarded the candidate should submit a report of the work done.

The following is a list of 10 courses arranged for two academic terms, with the proportion of the student's time which should be allotted to them. It is not expected that these courses or the division of time would be followed exactly in any institution, but it is hoped that they will serve to emphasize the principal topics which, under present conditions, need to be studied in preparation for public health administration work.

Model program for a 1-year course for medical graduates leading to the Diploma in Public Health.[1]

Required subjects.	Per cent of time devoted to instruction.	Special subjects.	Per cent of time devoted to instruction.
First term (four months):			
Hygiene	10	Review course or special subjects chosen by the candidate	10
Microbiology (bacteriology)	25		
Vital statistics	20		
Sanitary chemistry and biology	25		
Public health law and legislation	10		
	90		
Second term (four months):			
Applied hygiene	25	Special subjects chosen by the candidate	10
Preventive medicine	20		
Epidemiology	15		
Sanitary engineering	15		
Public health administration	15		
	90		
Third (summer) term (three months): Practical experience in hospital work, public health work, sanitary surveys. Tour of visits to sanitary works, or research.			

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[1] Or Certificate in Public Health.

Inasmuch as the phraseology of the subjects mentioned in the above list is not uniform in different universities, a syllabus has been prepared giving the important topics which should be included in the various courses. The lists given are so long that not all of the topics could be covered in one year without making the instruction too superficial. Variations in different schools must be expected and may even be desirable. Too much standardization is objectionable. Although the technical subjects require more time than those which relate to administration, it must not be inferred that they are more important.

HYGIENE.

Neuromuscular Activity.—Exercise, posture, fatigue, and restoration; rest and sleep; endurance; shock.

Circulation.—Muscular work of heart and blood vessels; vulnerable points of the circulatory apparatus; methods of testing circulatory efficiency; blood pressure.

Blood.—Formation of blood; chemical tests; methods of providing oxygen demand; blood· destruction; methods of determining excessive rate of destruction; altered blood pigment. Coagulation.

Respiration.—Modern views of respiration; composition of air. Muscular movements. Effect of high and low barometric pressures; effect of presence of hæmoglobin alterations, carbon monoxide; effect of increased concentrations of carbon dioxide. Lymph drainage of the lungs and phagocytic activity of lung cells. Inhaled foreign particles; their removal; varied effects of carbonaceous and siliceous dusts; biological damage done by dust.

Temperature Regulation.—Supply of heat from food combustion. Loss of heat by conduction, convection, and evaporation. Ventilation; automatic regulation; temperature and humidity of air. Exercise.

Nutrition.—Nature of foods; food values; balanced diet; vitamines; cooking. Physiology and hygiene of digestion. Metabolism: Fats, carbohydrates, proteins, mineral matter, minor substances; methods of study. The rôle of water. Effect of mental conditions, fatigue, and exposure on nutrition. Quantitative discussion of food supply. Effect of chemical preservatives. Tests of gastro intestinal contents.

Excretion.—Waste products, normal and abnormal. Urine formation; renal diseases. Perspiration.

Hygiene of the Skin.—Functions; care of skin surfaces. Bathing. Clothing.

Hygiene of the Eye and Ear.—Light: Eye strain; astigmatism; myopia; influence on general health. Deafness.

Physiology of Reproduction.—Sex hygiene: Education.

Alcohol, Tobacco, and other Habit-Forming Drugs.—Alcohol as a food, medicine, and stimulant. Tobacco, tea, and coffee. Patent medicines. Opium, cocaine, and other drugs.

Oral Hygiene.—Function of air passages. Infection of throat, nose, and ear, and sinuses. Care of teeth; troubles caused by decayed teeth. Relation between oral hygiene and nutrition.

Mental Hygiene.—Mental work; need of rest periods. Nervous strain.

Hygiene of the Feet.—Effect of shoes. Bathing. Flat feet.

Adaptation of the Body.

MICROBIOLOGY (BACTERIOLOGY).

Morphological and Cultural.—Morphology, development, and classification; cultural significance: Media, colonies, cultural features, biochemical features; staining of bacteria; identification of species.

Physiological.—Cell studies. Products of physical and physiological significance: Heat, light, pigments, enzymes, aromatic compounds, toxins, etc., plasmolysis, plasmoptysis. Metabolism: Growth, respiration, nutrition, moisture, temperature of cultivation, composition of media. Identification of species of microorganisms by means of cultural physiologic methods and chemical, physical, and biological tests. Studies in association: Symbiosis, metabiosis, antibiosis. Fermentative changes produced by microorganisms: Enzymes, fermentation. Effect of light, dry and moist heat, cold, thermotaxis, thermotropism, electricity, desiccation, mechanical pressure, mechanical agitation, gravity, chemicals.

Pathogenic Bacteria.—Identification methods; spreads, hanging drop, and special stains. Cultural methods: Tests for agglutination, precipitin, complement fixation, opsonic index, animal inoculation. Specific pathogenic properties of bacteria: Infections by staphylococci, streptococci, pneumococci, gonococci, meningococci. Infections by bacilli belonging to diphtheria, tubercle, typhoid, colon, dysentery, haemoglobinophilic, glanders, plague, anthrax groups. Anaerobic bacilli, tetanus, botulism. Vibrio infections, cholera. *Spirochaeta recurrentis*, treponema. Diseases of unknown etiology (including filtrable viruses, rabies, smallpox, vaccinia, yellow fever, typhus, trench fever).

Pathogenic Fungi, Yeasts, etc.—Yeasts, blastomycetes, molds, actinomycosis, sporothrix.

Pathogenic Protozoa and other Parasites.—Amebic dysentery, malaria, sleeping sickness, hookworm disease, tapeworms, trichina, etc.

SANITARY CHEMISTRY AND BIOLOGY.

Water and Sewage Analysis.—Collection of samples, choice of containers, shipment, allowable delay in analysis. Microscopic life; plankton, identification of algæ and protozoa; occurrence of organisms; factors influencing growth; effect of organisms on quality of water; quantitative determination of organisms; control of growth. Temperature measurement; temperature changes in large bodies of water; wind currents; circulation and stagnation. Dissolved gases; solubility of gases; carbon dioxide, its source and effect; oxygen, exhaustion and re-aeration, field methods; relation between gases and microscopic organisms; oxygen demand, biological and chemical. Taste and odor; observation; causes; methods of removal. Bacteria; genera; significance of certain forms; culture media; quantitative determination; *B. coli* group; *B. aerogenes*. Color; origin, measurement, significance. Organic matter; organic nitrogen; albuminoid ammonia; oxygen consumed; matter soluble in ether; loss on ignition; oxygen demand; stability. Nitrogen cycle; free ammonia; nitrites; nitrates. Solids: total, suspended, dissolved, fixed, volatile. Turbidity: origin, nature, field methods, laboratory methods. Chlorine: Normal chlorine. Hardness: Causes; significance; soap method; soda reagent method; chemistry of water softening; noncarbonate hardness. Alkalinity: Substances causing alkalinity; excess over hardness; indicators. Iron and manganese: Source; oxidation; effect on quality of water. Lead and poisonous metals: Sources; dangerous amounts. Interpretation of water analyses: Direct and indirect tests; comparates.

Air Analysis.—Temperature and humidity; thermometers; hygrometers; psychrometers; relative humidity; problems of air moisture. Pressure: Barometers. Movement: Anemometers, indicators, smoke clouds, velocities. Carbon dioxide: Index of vitiation; approximate and accurate determinations. Dust: Size and nature of particles; origin of dust; quantitative determinations. Bacteria and molds: Common forms; droplet infection; collection of samples; quantitative determinations.

Food Analysis.—Milk and cream: Fats; solids; gravity tests; preservatives and their detection; microbiological tests. Butter and butter substitutes: Chemical and microscopical tests; wholesome qualities. Flour and bread. Alcoholic beverages: Determination of alcohol; harmful ingredients. Adulteration of food: Substances to be tested for. Microscopical examinations, starch, pepper, mustard, coffee. Shellfish, bacteriological tests. Fermentation and putrefaction of food.

VITAL STATISTICS.

Statistical Arithmetic.—Collection of data; statistical units; accuracy and precision; inexact numbers. Computation of rates: Logarithms, slide rule. Classification of data: Groups, classes, series. Analyses of data: Grouping, averaging, mechanical devices.

Statistical Graphics.—Appeal to the eye; types of diagrams. Plotting; coordinates; group plotting; choice of scales. Special plotting; summation diagrams; logarithmic scales. Chart construction; legibility; lettering; coloring. Reproduction of diagrams.

Enumeration and Registration.—Population censuses. Registration of births and deaths: Swiss system, English system, etc. Notification of morbidity.

Population.—Methods of estimation—arithmetical, geometrical, graphic. Classification of population. Standard population.

Birth Rates and Death Rates.—General rates; corrected rates; adjusted rates. Specific death rates, by sex, age, race, occupation. Rates for particular diseases. Analysis of death rates.

Statistical Studies of Diseases.—Causes of death; international list. Studies of occurrence of particular diseases; nationality, age, sex, occupation, climate, season.

Advanced Statistical Processes.—Probability; chance; frequency; coefficient of variation. Correlation; causal relations; logical reasoning; mathematical relations.

Life Tables.—Methods of computation. Use of life tables.

Demography.—History of subjects. Importance of national statistics.

PUBLIC HEALTH LAW AND LEGISLATION.

Government.—Sovereignty; centralized governments; democracy; liberty and restraint. Common law; statutory law; constitutions. Executive, legislative, and judicial functions. Federal laws; State laws; local ordinances. Sanitary authority. Centralization *vs.* decentralization.

Police Power.—Police power: Safety, morals, health; source of police power. Check on police power: Due process of law. Use of police power. Delegation of police power.

Nuisances.—Nuisances *in esse* and *in posse:* Determination of nuisances; abatement of nuisances; personal liabilities. Regulation *vs.* prohibition. Licenses; permits.

Enforcement of Public Health Laws.—Civil and criminal actions. Judicial procedures. The nature of evidence; expert testimony. Injunctions. Public responsibility for contracts or negligence of officials. Personal liability of officials. Rules and regulations. Legal forms.

Law of Quarantine.—Origin of power. Conflict of authorities. International agreements. Personal liberty.

Taxing Power of Government.—General taxation. Special assessments. Public service.

Right of Eminent Domain.—Compensation to property owners.

Advisory Powers of Health Departments.

Medical Jurisprudence.

Relation between Economics and Public Health.

Labor and Factory Legislation.

APPLIED HYGIENE.

Infant Welfare.—Prenatal and maternal hygiene. Milk stations.

School Hygiene.—Physical examination. Heating, lighting, ventilation; seats and desks; sanitation. Posture; physical exercise. Medical and nursing service. Hours of study, work, rest. Dental service.

Factory Hygiene.—Employment; physical examinations; classifications. Medical, nursing, and sanitary service. Safeguards against accidents. Heating, lighting, ventilation. The dust problem. Noise, nervous strain, fatigue, hours of work. Welfare work, economic conditions, scientific management, recreation, education. Industrial insurance.

Industrial Toxicology.—Portals of entry for industrial poisons; habits of workers. Lead, arsenic, antimony, brass, mercury, phosphorus. Acids and alkalies; cyanides; carbon monoxide. Alcohols, aldehydes, acetones, acetates, ether, nitroglycerine. Benzine, nitro and amido compounds.

Mercantile Hygiene.—Medical and nursing service; emergency aid. Employment; physical examinations. Dental service. Rest rooms; lunch rooms. Heat, light, ventilation, sanitation.

Food Inspection.—Milk handling; farms, dairies; pasteurization. Markets; bakeries; food shops; restaurants. Delivery and household storage of food. Adulteration of food. Meat inspection. Drug inspections.

Military and Naval Hygiene.

Immunology.—Theories of immunity; natural, acquired, mixed, active, passive, local, general immunity. Virulence of microorganisms. Toxins and antitoxins; enzymes. Carriers; latency; lowered resistance. Antigens and antibodies. Antitoxic immunity; bactericidal immunity; phagocytosis; opsonins; lysins; hemolysis; cytotoxins; complement fixation; precipitins; agglutinins; amboceptors; antigens. Anaphylaxis and its clinical applications. Typing of blood.

Heredity and Eugenics.—General theories; variations; mutation; evolutionary theories; Mendel's law; atavism. Biometry. Heredity *vs.* environment. Hereditary transmission of diseases; inherited immunity; effect of alcohols and other drugs.

Prevention of Communicable Diseases.—Smallpox: Theory and practice of vaccination; duration of immunity. Rabies: Local treatment, Pasteur prophylactic treatment. Venereal prophylaxis; Wassermann tests; use of salvarsan. Preventable blindness; chronic inflammations; trachoma; ophthalmia neonatorum; wood alcohol. Tetanus: Resistance, prophylaxis. Typhoid fever: Modes of infection; use of Widal test; carriers; immunity from preventive inoculation; personal prophylaxis. Cholera: Diagnosis by bacteriological methods; inoculational prophylaxis. Paratyphoid fever; dysenteries; types; immunity; prophylaxis. Tuberculosis: Immunity; personal prophylaxis; sanatoria; segregation; suppression of bovine tuberculosis; tuberculosis in children. Diphtheria: Transmission; carriers; Schick reaction; toxin-antitoxin in active immunization; use of antitoxin. Tetanus: Antitoxin immunization. Measles. Scarlet fever. Whooping cough. Chicken pox. Mumps: Resistance; immunity; prophylaxis. Pneumonia: Diagnosis; types; immunity; prevention. Influenza: Colds; prophylaxis. Cerebrospinal fever. Epidemic meningitis. Anterio-poliomyelitis. Plague: Relation to fleas and rats; vaccine. Typhus fever, relapsing fever, trench fever: Relation to lice. Yellow fever, malaria: Relation to mosquitoes; use of quinine. Miscellaneous diseases: Leprosy, glanders, anthrax, trichina. Tropical diseases: Hookworm disease, amoebic dysentery, sleeping sickness.

Manufacture and use of Vaccines, Sera, Antitoxins, etc.—Smallpox, rabies, typhoid, paratyphoid, plague, cholera, tetanus, diphtheria, botulism.

Manufacture of Arsphenamine (Salvarsan).

Control of Insects and Animals.—Mosquitoes: Life history; habits; classification; methods of control. Flies: Life history; habits; classification; methods of suppression. Fleas: Life history; pulicides; relation to rats. Lice: Life history; methods of disinfection; insecticides; fumigation. Ticks, bedbugs, roaches, and other insects. Rats: Habits and classification; rat-proofing. Intestinal parasites. Diseases of animals transmissible to man: Anthrax, glanders, etc.

Disinfection.—Theories of disinfection: Physical and chemical. Standards: Methods of testing disinfectants; phenol coefficient. Use of gaseous disinfectants: Sulphur dioxide; formaldehyde; hydrocyanic acid; chlorine; ozone. Use of liquid disinfectants: Carbolic acid; bichloride of mercury; lime; chloride of lime. Use of alcohol, acids, and soaps. Effect of drying and exposure to sunlight.

EPIDEMIOLOGY.

Communicable Diseases.—Classification according to modes of transmission. Relative importance.

Historic Epidemic Diseases.—Plague, influenza, cholera, yellow fever; endemic centres; travel of epidemics.

Water-borne Diseases.—Typhoid fever: Notable outbreaks; longevity of *B. typhosus* in water; period of incubation; characteristics of a water-spread epidemic; pollution of river and lake waters; natural purification of water; pollution of wells; seasonal occurrence of water-borne typhoid fever. Dysentery; winter cholera; warning of typhoid epidemic. Cholera; notable outbreaks.

Milk-borne Diseases.—Typhoid fever; characteristics of milk epidemic. Scarlet fever, diphtheria, septic sore throat; notable instances. Tuberculosis.

Air-borne Diseases.—Air infection at short range; coughing; sneezing; mouth spray. Pneumonia; influenza; measles, whooping-cough, colds, etc.

Contact Infection.—Body contact: Shaking hands; kissing; sexual intercourse; touching objects in common; drinking cups, eating utensils, door-knobs; objects passed from person to person.

Insect-borne Diseases.—Physical transmission: Flies, typhoid fever. Blood transfer. Mosquitoes, fleas, lice, insects. Animal parasites: Trichina, tapeworms.

Earth Infection.—Hookworm; soil pollution; bare feet.

Investigation of Epidemics.—Search for common cause; need of statistics; logical use of facts; correlation; the detective's instinct; inductive reasoning. Dates of beginning of outbreaks; rise and fall of the epidemic; seasonal, sex, age, and occupational factors. Testing theories by facts; danger of hasty conclusions.

Early Discovery of Epidemics.—Need of closely following statistics: Maps, charts, and tables. Necessity of knowing normal conditions; use of the endemic median. Exchange of data between different health authorities.

Control of Epidemics.—Quarantine; isolation; segregation; protection against contact. Removal of original cause, if found. Protection against spread of disease by known methods.

Geography of Disease.—Relation to climate; movements of people; transportation; quarantine.

SANITARY ENGINEERING.

Municipal Sanitation.—City plans: Relation of streets to public health; building restrictions. Municipal administration: Appropriations for public works. Contracts and specifications; reading maps and plans; the cost factor in engineering work; measurement of value received. Water consumption; waste of water; variations in water consumption and their effect on design. Rainfall measurement; rainfall records; stream flow; storage; yield of catchment areas; reservoir sites. Effect of storage on quality of water; sanitary protection of watersheds. Geology of ground water; methods of utilizing ground water; pumping water. Requisite quality of public water supplies; principles of water purification; aeration; sedimentation; coagulation; sand filters; mechanical filters; disinfection of water; water softening; iron removal; control of water purification; value of pure water; cost of water purification. Distribution of water: Sale of water. Sewerage systems: Volume and variations of sewage flow; composition of sewage; river and harbour pollutions. Principles of sewage treatment: Physical methods, screening, sedimentation; chemical processes; application to land; biological processes, contact beds, trickling filters, activated sludge; sludge disposal; disinfection. Disposal and treatment of manufacturing wastes. Disposal of solid wastes; street cleaning; garbage incineration; garbage reduction. Smoke prevention; dust.

Rural Sanitation.—Farm buildings: Sites, arrangement, construction. Protection of dug wells; small pumping units. Simple methods of excreta disposal; disposal of sewage; utilization of human excrement as fertilizer. Methods of handling animal manure; the fly problem. Mosquito control: Swamp drainage.

Building Sanitation.—The housing problem; building materials. Construction; fire protection; rat proofing; insect control. Sunlight; artificial lighting. Heating; the fuel problem. Ventilation: Air purification; air conditioning; recirculation. Plumbing regulation: Distribution and heating water; plumbing fixtures; house drainage; inspection of plumbing; deterioration of plumbing.

PUBLIC HEALTH ADMINISTRATION.

History of Public Health.—Principles of administration: Legal basis; single executive plan *vs.* boards of health; staff organization and line organizations; organization of departments. Responsibility, accountability, and authority; financial responsibility. The budget system. Executive, legislative, and judicial powers; advisory powers; delegation of police powers. Centralization and decentralization. Full-time service; compensation of health officers; tenure of office; civil service; political and diplomatic considerations.

Public Health Authorities.—Ministries of health; national departments; State departments of health; local boards of health; international health matters.

Medical and Nursing Service.—Relation of medical service to public health authorities. Organization of public health nurses, official, semiofficial, private agencies.

Hospitals and Institutions.—Hospitals: Contagious-disease hospitals; private hospitals. Public institutions: Prisons; homes for the aged; charity homes. Dispensaries: General drug dispensaries; special. Clinics: Tuberculosis; venereal diseases, etc. Day nurseries. Public health education. Research; new discoveries; annual and special reports. Popular education: Printed matter; exhibits; cinemas; health crusades. Sanitary surveys.

Details of Administration.—Equipment of offices and laboratories; inspection service; use of statistics; hearings; reports; dealings with the public; preparedness for emergencies; relief work in connection with fires, floods, and other catastrophes.

Nonofficial Health Agencies.—Red Cross societies; social service; women's clubs; chambers of commerce; and many others.

Offensive Trades.—Inspection, regulation, prohibition; control of nuisances.

Relative Value of Health Activities.

Spirit Versus Program.

The writer realizes the futility of a program like the one proposed unless the instruction is carried on with the proper spirit and unless all the instructors have the public health point of view. It is not satisfactory to have the instruction given in a medical school by medical men whose major interests are connected with the training of physicians. The setting up of a special school of public health is important, if for no other reason than that it focuses the minds of both teachers and students on the main subject. Just as public health is a composite subject, so must the school be a composite school and include not only physicians but sanitary engineers, administrators, and skilled laboratory specialists. Sanitary engineering can be much better taught by an engineer who knows something about preventive medicine than by a doctor of medicine who knows something about engineering. The advances which the American schools of public health have made in recent years are due largely to this spirit of cooperation between the different professions and to the fact that it has been possible to secure as teachers, doctors, engineers, chemists, lawyers, and others who are willing to direct their expert knowledge to the field of public health and who regard it as one of their major interests in life.

Next in importance is the laboratory method of teaching. Emphasis should be placed upon the laboratory and the part which it is bound to play in public-health administration. In the hands of modern science public health is a living, growing thing. It is a subject which lends itself to the experimental method. There should be not only chemical and biological laboratories but engineering laboratories and laboratories of statistics.

Students must also be brought into contact with actual work. This is necessary in order to get the proper perspective of sanitary works, in order to see how a health official orders his life and his work, and in order to visualize the magnitude of the public-health problems which await solution. This kind of close contact with actual health administration is as necessary for the health officer as interneship in a hospital for a young physician or apprenticeship for a young mechanic.

There are four principles, then, which transcend in importance the program of studies above outlined: First, the establishment of a school of public health; second, instruction by specialists in different fields working in cooperation; third, emphasis upon the laboratory method; and, fourth, contact with actual work.

Program Leading to the Degree of Doctor of Public Health.

The degree of doctor of public health should be regarded as the highest degree in this field. At the present time the opinions of educators are divided as to whether the medical degree should be prerequisite or whether there should be a special course of study leading directly to the degree of doctor of public health.

If the medical degree is required, it seems clear that the degree of doctor of public health should require two years' study in residence, or perhaps one year of practical work under suitable direction following the one-year diploma course above mentioned. In the ordinary medical school the last year's studies for the degree of doctor of medicine are largely elective and devoted to practical work; and in the same way the second year of the supplementary course leading to the degree of doctor of public health might be devoted to practical work in some special branch of public health. This arrangement would mean that the student would spend six years getting his two degrees—namely, M. D. and Dr. P. H.—and that two of the years would be spent largely in practical work in two very different fields—curative medicine and public health administration.

If the medical degree is not required, the student, after having received a bachelor's collegiate degree, should be required to pursue two years of approved medical studies, followed by two years of public-health studies along the lines already mentioned, or it might be better for him to devote three years to medical studies and one year to public-health studies. In either case the course would lead to the degree of doctor of public health after four years, and this degree would be the academic equivalent of the degree of doctor of medicine.

In some countries the medical course leading to the degree of doctor of medicine covers five, six, or seven years, instead of four years. Where this is the case the time schedules mentioned in this paper would naturally have to be extended in order to make them apply to local conditions.

It is perhaps too early to lay down a standard program for the four years of medical and public-health studies which should be included in a course leading to the degree of doctor of public health, for the reason that new schools of public health are being organized and educational opinion has not yet crystallized. Furthermore, the diploma (or certificate) course is able to take care of present needs.

The accompanying diagram is a schematic outline of the possible arrangements for such a course as compared with the ordinary courses leading to the degree of doctor of medicine and the diploma (certificate) in public health.

In this diagram the program leading to the diploma (or certificate) in public health is shown on the left, and three alternate programs leading to the degree of doctor of public health are shown on the right. The diploma program provides for premedical work for four years in the medical school and for one year of public-health studies, including an extra summer of practical work. The first program leading to the degree of doctor of public health provides for premedical work for four years in the medical school, two years of public-health studies, including practical work during the summer. The second program requires a bachelor's degree, two years of medical studies followed by two years of public-health studies, provision being made for practical work during the summer. The third program requires the bachelor's degree, three years of medical studies followed by one year of public-health studies, with an extra summer of practical work. The degrees of bachelor of arts and bachelor of science, prerequisite for obtaining the degree of doctor of public health under Plans 2 and 3, may not be given in certain countries of continental Europe. In such cases a preparation equivalent to that obtained by holders of these degrees should be necessary.

These plans are given here merely as a basis of discussion. A committee of the American Public Health Association, appointed to consider the standardization of public-health training, has recently made a report substantially along the lines above described, and in a few years it may be possible for an acceptable program of study to be set up as a model.

Cooperation of the Universities.

In an article on "World-wide sanitation," published in the first number of the International Journal of Public Health (July, 1920), the writer pointed out the great need in all countries of more hygienic living conditions as a foundation for better health and explained the importance of having men trained in medicine, public-health administration, and sanitary engineering. In the long run these men can be educated best in their own countries and in their own language. All the universities in the world must therefore do their part. There should be at least one school of health in every country where men can be educated as public-health executives. This can be brought about in many cases by combining the existing facilities in universities, by the cooperation of medical schools with engineering schools, and by the cooperation of universities with active departments of public health.

SUGGESTED PROGRAMS OF STUDY.

	Diploma in Public Health	Doctor of Public Health		
		First plan.	Second plan.	Third plan.
Premedical Studies.	⬚ Physics, Chemistry, Biology.	⬚ Physics, Chemistry, Biology.	⬚ Physics, Chemistry, Biology.	⬚ Physics, Chemistry, Biology.
Degree.			A. B. or S. B.	A. B. or S. B.
First Year.	▭ Anatomy, Physiology, Bio-chemistry, Histology.	▭ Anatomy, Physiology, Bio-chemistry, Histology.	▭ Anatomy, Physiology, Bio-chemistry, Histology.	▭ Anatomy, Physiology, Bio-chemistry, Histology.
Second Year.	▭ Pathology, Bacteriology, Parasitology, Pharmacy, Medicine, Surgery.	▭ Pathology, Bacteriology, Parasitology, Pharmacy, Medicine, Surgery,	▭ Pathology, Bacteriology, Parasitology, Pharmacy, Medicine, Surgery.	▭ Pathology, Bacteriology, Parasitology, Pharmacy, Medicine, Surgery.
Third Year.	▭ Medicine, Surgery, Pediatrics, Obstetrics, Dermatology, etc.	▭ Medicine, Surgery, Pediatrics, Obstetrics, Dermatology, etc.	■ Hygiene, Sanitation, Preventive Medicine, Statistics, etc.	▭ Medicine, Surgery, Pediatrics, Obstetrics, Dermatology, etc.
Fourth Year.	▭ Special Studies in: Medicine, Surgery, Obstetrics, etc.	▭ Special Studies in: Medicine, Surgery, Obstetrics, etc.	■ Special Studies in: Public Health Science and Practice, etc. ▤	■ Hygiene Sanitation, Preventive Medicine, Statistics, etc. ▤
Degree.	M. D.	M. D.	Dr. P. H.	Dr. P. H.
Fifth Year.	■ Hygiene, Sanitation, Preventive Medicine, Statistics, etc. ▤	■ Hygiene, Sanitation, Preventive Medicine, Statistics, etc. ▤		
Sixth Year.	Diploma in Public Health (or Certificate in Public Health).	■ Special Studies in: Public Health Science and Practice, etc.		
Degree.	D. P. H. or C. P. H.	Dr. P. H.		

⬚	Premedical Studies.
▭	Studies in Medical School.
■	Studies in School of Public Health.
▤	Practical work under direction during summer.

In order to promote the rapid building up of such schools, the practice should be established of sending students or young instructors from the universities where the proper courses of study do not now exist to some of the older schools in Europe or America. After coming in contact with the most modern ideas these students and young instructors would go back to their universities with a new inspiration to found in their own countries courses in public health, to establish laboratories and clinics, to build sanitary works, and to adopt other means of improving the health conditions of their peoples. Later on arrangements should be made for professors in the existing schools to give short courses of lectures in the new schools established in other countries. The Japanese nation has risen rapidly in recent years, largely because of the practice of sending her students and professors to other countries, not only to receive but also to give instruction. This example is one which should be followed by other countries.

At the present time the available textbooks do not cover thoroughly the subjects which are included in the diploma course in public health. This is true of all languages. In English there are excellent books on hygiene, bacteriology, and preventive medicine, but there are no books on public health administration, epidemiology, water analysis, or sanitary engineering which are fully adapted to the program. In German there are satisfactory books in most, but not all, of the subjects. In French there are a few good books on hygiene, which cover a wide field, and there are some well-written engineering books applicable to the diploma program; but there are no adequate books on vital statistics or administration. In the other languages the lack of proper textbooks is greater, although several excellent books in Dutch, Spanish, and Swedish have been brought to the writer's attention. This is a problem which new schools of public health will have to solve. The readiest method of providing textbooks is by translation from one language to another. For example, there is an excellent German book on water analysis which might be translated into English, an American book on vital statistics which is now being translated into Spanish and Japanese, and which might be translated into French, German, and Italian. There are many short articles in Roumanian, Czech, Russian, and other languages which should be made known to the world. The universities have here an excellent opportunity to spread the knowledge of the principles and scientific facts underlying public-health administration throughout the world.

In order to bring about this cooperation it is necessary to have some organization which can serve as a center for collecting and distributing information and for keeping record of the progress of the educational movement in public health in all hands. The League of

Red Cross Societies, with its wide connections, with its staff of experts at Geneva, with its International Journal of Public Health, with its corps of sanitary correspondents scattered through many countries, and with its connections with the League of Nations, is well fitted to perform these functions. The league should maintain at Geneva a complete set of the annual calendars of all universities, lists of courses offered in public health subjects, lists of the textbooks available in the different languages, should provide for translations of works of major importance, and should, in general, act as a clearing house for information on the subject of public health education.

Underlying Motives.

In conclusion the writer wishes to emphasize the fact that this movement, which looks forward to a more effective public health service, is in line with the spirit of the times which demands better living conditions for all the people, especially the people who work with their hands and who, through ignorance, poverty, or neglect, can not or do not protect themselves as they might against the ravages of controllable diseases. It is in line with the demand for improved industrial conditions, for the better development of the natural resources of the world, and for closer commercial relations between the nations. But more than all this, it looks forward to a betterment of humanity. If the materialism of western civilization, so dominant as a result of the use of power, remains an end in itself, civilization will have retrograded; but if modern science is used not only to construct things mechanical but to improve the bodies and souls of human beings and bring health and happiness into their lives, civilization will have made its greatest step forward. The crisis rests upon the present generation. Disease will always exist in the world, for it is man's fate to die. The physician will always be needed. But science is teaching us how to mitigate suffering, how to prevent disease, and how to strengthen human bodies and keep them sound, and hence the coming century will demand not only schools of medicine but schools of public health.

THE NOVEMBER HEALTH INSTITUTE IN NEW YORK CITY.

The first of a series of health institutes is to be given in New York City during the five days from November 8 to 12, 1921. This institute differs from the other regional institutes, which are to be held by the United States Public Health Service, in that it is sponsored not only by the Public Health Service but also by the American Public Health Association, the New York State Department of Health, the New York City Department of Health, the New York Academy of Medicine (public health committee), and the National